ARTICLE XXV.

On a New Variety of Asphalt: (MELAN-ASPHALT.) *By Charles M. Wetherill, Ph. D. Read July* 16, 1852.

History.—In the spring of 1851, I was called upon to make a chemical examination of this substance in connexion with the late Richard C. Taylor, who was sent to the locality to define its geological position. An unfinished paper, intended for the Transactions of the Society, upon which Mr. Taylor was engaged at the time of his death, is published in the Proceedings for January 16th, 1852. I would refer to this paper and also to a pamphlet, entitled "Abraham Gesner *vs.* Halifax Gas Light Co. Deposition of Richard C. Taylor, respecting the asphaltum mine at Hillsborough, in the county of Albert, and province of New Brunswick," for a full description of the geological situation of the mineral. And, besides the above-mentioned papers, to a pamphlet, entitled "Report on the Albert Coal Mines, &c., by Dr. Jackson," and to an answer to this Report by a "Fellow of the Geological Society of London." Owing to a law suit in which great interests were at stake, the mineral in question has been examined as to its chemical behaviour by a large number of experts, who are singularly divided as to their conclusions. My examination was made at various times, upon specimens obtained from Mr. E. Le Gal, and from the Philadelphia Gas Works, where it is used as a substitute for rosin for increasing the illuminating power of the gas.

Description and Analysis.—In appearance it is of brilliant jet black colour, of high resinous lustre; fracture perfectly conchoidal and brilliant. Hardness between one and two of Mohs' scale. Density 1·097. When very finely powdered and placed in a large bottle, it appears brown when looking at the part adhering to the glass; when coarsely pulverized, is black. If fine particles be chipped from a solid mass of the mineral, and examined under the microscope, they will be found transparent, of brown colour on the thin edges, and where the radiating lines observed in resinous bodies which have a similar fracture, happen to radiate towards the aforenamed edges, fine spiculæ will be observed at the extremities of some of the radii, perfectly transparent and of brown colour. These results with the microscope had been previously obtained by Dr. Leidy, who made a comparative microscopic examination with the mineral in question, with the asphalts, and with coal.

Thrown into boiling water it became softer to the nail, but could not be moulded between the fingers. Held in the flame of a candle in such manner as to prevent as much as possible the action of oxygen, it gave evidence of incipient fusion, and adhered to paper when placed in contact with it. Thrown into boiling coal tar pitch, it softened, could be kneaded between the fingers like wax, and on cooling presented the same appearance as to fracture, &c., as before. Tested for nitrogen by Lassaigné's method, and for sulphur by fusion with nitre and caustic potassa, affirmative results were obtained.

In an examination for volatile matter, one gramme gave 0.5555 vol. matter, 0·4435 coke, and 0·001 of reddish ash, which corresponds to a per centage of

Coke, . . .	44·35
Volatile matter, . .	55·55
Ash, . . .	0·10
	100·00

The coke, which was very porous, was burned off by a slow current of oxygen introduced into the platinum crucible. A portion of the asphalt in a Hessian crucible with luted cover, was placed in a wind furnace, and the heat gradually raised to full redness, at which it was kept for some time. The coke thus obtained was of light gray metallic appearance, and exceedingly porous, and throughout its mass exhibited laminæ, concentric to the sides of the crucible, like the coats of an onion. A portion of the asphalt was melted by the following process. It was introduced into a Florence flask, to which was adapted a long bent tube for the purpose of condensing and collecting the products of distillation, and placed over a gas lamp; the temperature was carefully and gradually raised. At first white fumes burning with a bright light made their appearance, which were not condensed by the application of cold water. After these, the naphtha came over, with the odour of mineral naphtha, and also somewhat resembling the odour attending the distillation of stearic acid. The asphalt in the flask broke up into smaller pieces, which continued to separate until they became of the size of a small pea; they then fused together and formed a perfectly liquid mass, with gentle ebullition, and of the consistency of molasses, or even more mobile. Some of this poured out into a broken flask, solidified, and when cold, presented a fracture like that of the original substance, but somewhat less brilliant, and which, though quite hard, appeared more impressible to the nail than before fusion. This experiment was performed twice upon the asphalt which was obtained at the Philadelphia Gas Works.* In each case, just before liquefaction, a white sublimate condensed in that part of the tube nearest to the flask. It appeared crystalline and soluble in water; though the re-action was less apparent, owing to the small quantity, and to its being impure from condensed naphtha. Rammelsberg (1st supplement Handwörterbuch des Ch. Theils, der Mineralogie) notices an asphalt from Murindo, Columbia, which according to Mill, contains much Benzoic acid, which can be obtained by alcohol, or by sublima-

* The second experiment was performed upon part of a specimen from the Philadelphia Gas Works, which had been put away and labelled in my cabinet. It was performed to avoid all chances of error.

tion, and which is otherwise unknown. The sublimate from the melan-asphalt may have some connexion with that of Mr. Mill, though its scarcity prevented further examination. Portions of the sublimate and of the melted asphalt were given to the Commissioners at my examination.*

The behaviour of the melan-asphalt towards solvents, compared with that of Egyptian asphalt and cannel coal, is shown by the following table. The object of these experiments with menstrua, was not so much *solution*, as *comparison* of solubility. The conditions were therefore kept as much alike as possible. One thirty-second of an ounce of substance was added to one fluid drachm of solvent. The mixtures stood from Saturday to Monday, and were then boiled for about a minute and left to settle.

	A	B	C
Kind of Menstruum.	*Melan-asphalt.*	*Egyptian asphalt.*	*Cannel coal.*
Lard Oil.	Brown solution, residue.	Like A, but much more dissolved.	Not tried.
Linseed Oil.	do.	do.	No solution.
Naphtha distilled from the rocks at the locality of the melan-asphalt.	Deep brown solution, residue.	Like A, more in solution.	No solution.
Mineral Naphtha.	do.	do.	Not tried.
Wood Naphtha.	No solution.	Solution light yellow.	Not tried.
Purified Coal Naphtha.	Brown solution. Less residue than by preceding solvents.	Very soluble, but little residue.	Not tried.
Turpentine.	Soluble, with residue.	Soluble, with little residue.	No solution.
Chloroform.	Quite soluble. Residue.	Soluble, no residue.	No solution.
Ether.	Light yellow solution.	Deep brown solution.	Light yellow solution.
Absolute Alcohol.	Alcohol not coloured.	Light yellow,	Alcohol not coloured.

When raised to the boiling points in coal-tar and coal-tar pitch, the melan-asphalt was softened that it might be moulded into any shape, and when hard on cooling, its fracture was the same as before the experiment. The Egyptian asphalt disappeared completely, while the cannel coal was not in the least affected.

From the experiments made with a view to the solubility of the asphalt in several menstrua, I would infer that its solubility depends much upon the fineness of the powder and length of time of the action. A flask was half filled with oil of turpentine, and to its neck was adapted, by means of a cork, a bent tube, to which was melted one of larger diameter in connexion with a Liebig's condenser, so that the whole system made an obtuse angle with the axis of the flask. Pieces of the asphalt of the size of a hazelnut were introduced into the widened tube, and the turpentine brought to the boiling point. The turpentine vapours condensing upon the asphalt took it in solution pouring down again

* I find by a subsequent experiment, that the fusion is not facilitated by an atmosphere of carbonic acid. Melan-asphalt, like amber, (which it much resembles) appears more readily soluble after fusion. After fusion it is electric. I have never found any difficulty in fusing melan-asphalt in a flask; but the experiment requires to be performed with care.

into the flask. This method of solution proposed by Mansfeld as an easy mode of attacking the resins was found of little avail for the substance under experiment. A deep brown solution was at length obtained, but requiring a longer time than by subsequent methods. If the substance be powdered ordinarily fine, the solution is more readily effected by oil of turpentine;—and the solution is still more easy if it be pulverized extremely fine and passed through bolting cloths. The successive additions of turpentine are all coloured. If, after treating once with oil of turpentine, oil of peppermint be added to the residue, a fresh quantity appears to enter into solution; and if coal naphtha be added to this residue, another portion of the asphalt will be dissolved. E. Durand, of this city, obtained for the solubility of Cuban asphalt, thirty-four parts in ether—sixty in oil of turpentine, and six residue; and of melan-asphalt in ether four, in turpentine thirty, and residue sixty-six.

Dr. A. A. Hayes, in two experiments, obtained from two hundred parts of melan-asphalt, by action of oil of turpentine, seven and three-tenth parts, and five and seven-tenth parts, dissolved. Dr. Hayes tried the action of other solvents, the residue from which, without further examination, he pronounced coal. The residue, from my experiments with solvents, when examined under the microscope with moderate powers, presents all the brilliancy of lustre and transparency on the thin edges with brown colour, of the original substance. If the finely powdered asphalt be examined with the microscope before action with solvents, particles will be observed here and there of such fineness as to transmit brown light; mingled with these are others, thick, of brilliant black colour, and opaque, but on the edges of some, thin enough to be transparent. If the residue be examined during the action of the several solvents, these fine fragments will be observed to disappear gradually, until at last the coarser ones alone remain, and which are here and there thin enough at the edges to be transparent. The experiments of solution are beautifully exhibited on thin scrapings in a watch glass with the solvent in the field of the microscope. In the case of the very minute particles, an almost invisible skeleton of the earthy constituents is left. Comparative experiments with asphalt from Cuba and with melan-asphalt gave the following reactions. The substance was not very finely powdered. The shades were deeper in the case of the Cuban asphalt.

With Naphtha, . . .	Deep brown solution.
Oil of Vitriol, . . .	Deep brown solution.
Caustic Potassa, . .	Slightly yellow.
Cold Nitric Acid, . .	No action.
Boiling Nitric Acid, . .	Light yellow resulting liquid.

Mr. William Rice, manufacturer of marine paint in this city, states, in a letter to the late Richard C. Taylor, that he found the asphalt in question to dissolve in coal tar, coal tar pitch, coal naphtha and turpentine, with the formation of a beautiful varnish.

Organic Analysis.—The combustion of melan-asphalt with oxide of copper gave for 0·858 grammes; carbonic acid 2·707, and water 0·6925. For nitrogen, by Erdman and Marchand's method, 0.589 gave twenty-three cubic centimetres of moist nitrogen, at 12°C. and 763·4 millimetres barometric pressure, for which the usual corrections were made.

A specimen of asphalt from Cuba was analyzed at the same time. Its density was 1·117, its relations of vol. matter, &c., as follows:—

Coke,	32·00
Vol. Matter,	67·60
Ash,	0·40
	100·00

The percentage relations of the two analyses are as follow:—

	Cuban Asphalt.	Melan-Asphalt.
Carbon	82·339	86·037
Hydrogen	9·104	8·962
Nitrogen	1·910	2·930
Sulphur	traces	traces
Oxygen	6·247	1·971
Ash	0·400	0·100
	100·000	100·000

Subtracting the ash, and uniting the nitrogen and oxygen, we have

	Cuban Asphalt.	Melan-Asphalt.
Cuban	82·670	86·123
Hydrogen	9·141	8·971
Oxygen and Nitrogen	8·189	4·906
	100·000	100·000

Taking carbon one thousand, we have in

	Cuban Asphalt.	Melan-Asphalt.
Hydrogen	110	104
Oxygen and Nitrogen	99	57

In calculating the formula for the Cuban asphalt, neglecting the nitrogen, it would give $C_{35}H_{23}O_2$. The formula for melan-asphalt would be $C_{68}H_{42}O,N$, in which the number of equivalents of C and H for one of O, is nearly fourfold that in the case of the Cuban asphalt.

The melan-asphalt, like that from Cuba and Egypt, becomes *highly electrified by friction.* Coal does not present this phenomenon.

The question as to the constitution of the asphalts, with a view to their classification, has been much neglected by chemists, yet it is an interesting one, as throwing great light upon their origin, which remains in a state of uncertainty. Among the bitumens and asphalts, there exists a great variety as to external appearance, consistency, solubility, and proportion of elementary constituents. Boussingault in his "Memoire sur la Composition

des Bitumes," (Ann. de Ch. and Ph., lxiv. 141,) has sought a classification with regard to their contents of Petrolène and Asphaltène, which he supposes would account (by varying mixtures) for the above mentioned differences.

Petrolène, from his experiments, contains

Carbon, ...	88·5
Hydrogen, ...	11.5
	100·0

and is isomeric with oil of turpentine. Asphaltène is $C_{20}H_{16}O_3$ containing

Carbon, ...	75·0
Hydrogen, ...	9·9
Oxygen, ...	14·8
	99·7

The bitumen of Bechelbronn, which, according to Boussingault, is a mixture of 85·4 petrolène and 14·6 asphaltène, contains,

Carbon, ...	86·8
Hydrogen, ...	11·2
Oxygen, ...	2·0
	100·00

The asphalt from Coxitambo bears a great analogy to the melan-asphalt. According to Boussingault, "its fracture is largely conchoidal, it is of great brilliancy, and would be taken from its black colour and lustre for obsidian." Its density (Loewig, from Boussingault) is 1·08. It dissolves *with great difficulty* in petrolène and in the fat oils, which Boussingault supposes to arise from "the great cohesion of the natural asphalt." By a later analysis by this celebrated chemist, (Ann. de Ch. and Ph., lxxiii.) it has the following composition, which will bear comparison with my results for melan-asphalt.

Carbon, ...	88·63
Hydrogen, ...	9·69
Oxygen and Hydrogen, . . .	1·68
	100·00

From the foregoing analysis and behaviour I infer that the substance from Hillsborough is not coal, nor any variety of coal, but a true and a new variety of asphalt. In allusion to its beautiful and brilliant black colour, I propose for it the name melan-asphalt.